FIELD MUSEUM

OF NATURAL HISTORY

Perspectives: 1992

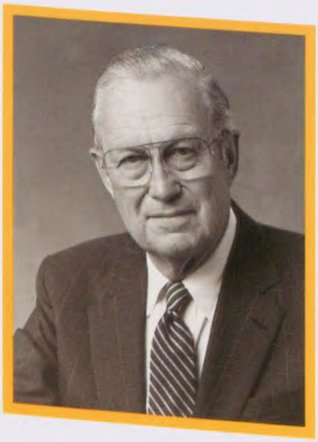
A World Treasure

MUSEUM CURATORS HAVE THE unusual talent of being able to concern themselves simultaneously with the minutiae of form or function in some perhaps obscure group of species, and with grand questions of the structure of life on earth. Here we have Rüdiger Bieler slicing up his worm-snails and Bennet Bronson digging up ninth-century dinner plates, Lance Grande musing upon living and fossil paddlefishes and Thomas Lammers counting the chromosomes of Lobeliaceae. At the same time, they and their Field Museum colleagues are exploring the processes—geological, biological, technological—that have shaped today's world and are continuously reshaping tomorrow's.

As new knowledge has been synthesized in this way, the Museum has updated and upgraded its exhibits. "Into the Wild: Animals, Trails & Tales" is our latest major reworking of the Museum's collections in an effort to better reflect current understanding of the natural world and ways of teaching about it.

The work described here is of course only a small fraction of the Museum's research and education program, universally respected for its innovations and seriousness of purpose. We Chicagoans hold in trust a world treasure, and must maintain its leadership position in the decades ahead.

Frank Considine
Chairman, Board of Trustees



Bottom: *Serpulorbis* sp., a vermetid worm-snail from the Bahamas; eating its particle-trapping feeding net.

Immature Snails and Grownup Science

EVERY TEN-YEAR-OLD WHO HAS walked along a beach or down a forest path knows that life is mostly bugs and slugs and little things with shells. But grownup researchers—and, more to the point, the sponsors of grownup research—tended to relegate these creatures to the attics and cellars of the house of science, with the result that many thousands of invertebrate species have yet to be observed, described, and classified. In turn, that means that our knowledge of the evolution and relationships of the world's most diverse groups of animals is limited and tentative.

By the same token, however, good scientists who do choose to study invertebrates have a chance to make major contributions, and this fact of academic life, together with the discovery of strange new species of mollusks at "hot vents" in the ocean floor, has in the past decade stimulated a resurgence of field work, laboratory analysis, and evolutionary theory.

R. BIELER

From a boyhood fascination with marine shells, Field Museum zoologist Rüdiger Bieler developed a research interest in snails and bivalves and their evolution, and his first field work, in Africa, established that populations of sundial snails in many parts of the world, previously thought to be separate species, were in fact the same—the adult form of free-swimming larvae traveling amid oceanic plankton. This upset long-held hypotheses about the evolution and distribution of this group.

There are perhaps 100,000 species of snails and slugs and 20,000 species of bivalves. Bieler's work has simultaneously focused on particular groups of snails and bivalves of special interest to evolutionary studies and widened to encompass a critique of conventional divisions of the largest classes of mollusks.

J. WEINSTEIN/GN-86271.33A

Top: **Underwater photograph of worm-snail habitat in barrier reef off the coast of Belize.**

Bottom: **Dr. Rüdiger Bieler, in the new histology lab, prepares stains of worm-snails for study.**

Because most previous analysis has emphasized one or another feature of the shells or other hard parts, Bieler uses many techniques to study soft-tissue anatomy and reproductive biology. This yields a greater variety of characteristics that can be compared to infer the relationships of species. Interestingly, one approach combines traditional thin-sectioning of specimens—Bieler has established a new histology lab at the Museum—with sophisticated three-dimensional computer imaging.

The limitations of analysis based on shell form were apparent in the case of the vermetid gastropods, the "worm-snails" that cement themselves to underwater structures and in some cases build reefs like the "worm" reefs south of Bermuda. Three aspects of their behavior are of economic and environmental importance: They are "fouling" organisms that clog ships' hulls; as filter-feeders, they collect and could provide indexes of pollutants in the water; and their reef-building activity could become part of coastline-protection schemes. But absent an accurate classification of species, experiments involving worm-snails could not be confidently replicated. Their shells are highly variable, and it was only when Bieler was able to analyze their reproductive biology and certain other features that it became clear that they were members of several groups not closely related.

Fishes, Anatomy, and Geography

PADDLEFISHES ARE A PECULIAR GROUP represented today by only two living species. One, *Polyodon spathula*, lives in the Mississippi River drainage of eastern North America while the other, *Psephurus gladius*, inhabits the Yangtze basin of China. The paddlefishes are among a dozen or so fish families containing "living fossils" (living species belonging to otherwise extinct major groups). *Polyodon* and *Psephurus* are a bit like living dinosaurs, and studying them together with well preserved fossil forms can tell us much about evolution and earth history.

J. WEINSTEIN/GN-86272.21

Paddlefishes undergo drastic changes between their juvenile and adult stages. Without an understanding of the living fish, juvenile and adult fossils could be misinterpreted as completely different species. Last year Field Museum paleontologist Lance Grande and his colleague Willy Bemis, a Museum research associate, published the first detailed comparative anatomy of fossil and living paddlefishes and a proposed evolutionary tree for the group. They are now working on bowfins, another primitive group of ray-finned fishes that has one living species and about fifty fossil species.

Grande limits his research to those groups that have at least one living representative and well preserved extinct (fossil) species. Fishes are ideal subjects for comparative anatomy of fossil and living species because they have complex skeletons that are frequently preserved in detail in the fossils, presenting many points of comparison with the living species.

Grande is more interested in fishes than in distinctions between zoological and paleontological species. "If you're looking at evolutionary problems, it's all part of the same picture," he says. The picture he's working on is of the evolutionary relationships and geographic distribution over time of the ray-finned fishes—a group that includes about 50 percent of all known vertebrate species.

L. GRANDE

Top: **Dr. Lance Grande amid a large grouping of 52-million-year-old fossils from his field site in the Green River Formation, southwestern Wyoming.**

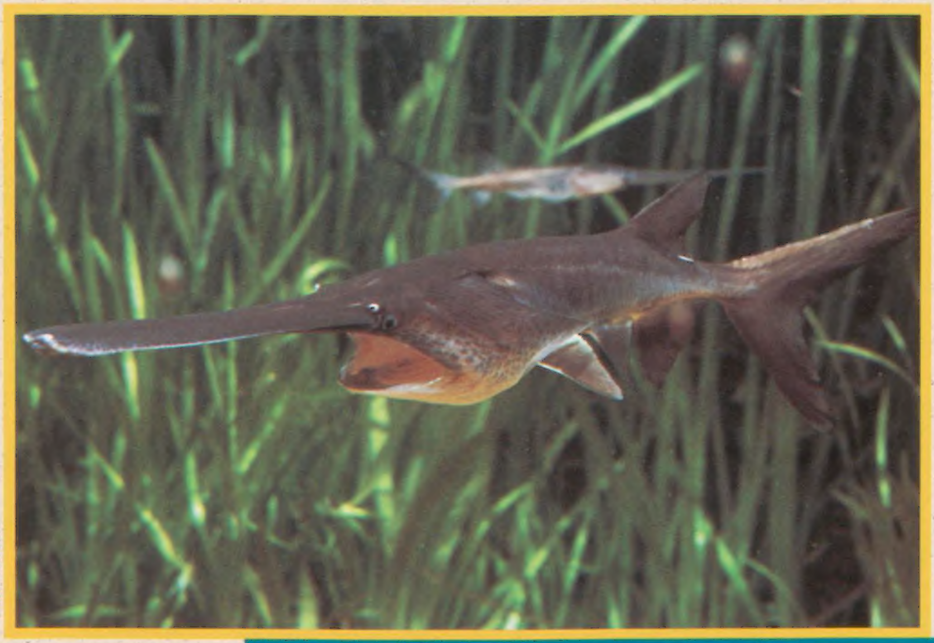
Bottom: **One of Grande's fossil fish quarries in the Green River Formation.**

"I'm trying to find some general and historical information that's not only relevant to the ray-finned fishes but also to our basic understanding of evolution," Grande says. "So I look at ontogeny, at phylogeny, at paleontology and biogeography"— that is, at a creature's development from conception to maturity, at its comparative anatomy with other related species, and its area relationships (where does its closest relative live?).

Groups like the paddlefishes indicate a biogeographic link between North America and China. In southwestern Wyoming, Grande observes, "we find many groups of fossil fishes indicating a strong trans-Pacific tie for western North America. The pattern is so strong that there must be a geological explanation for it." Strong patterns of area relationships based on organisms led geologists to develop theories as basic as continental drift and plate tectonics. As Grande puts it:

"Relationships of organisms together with their distribution indicate that the connections between continents were different in the past than they are today. We are seeing the results of the earth's organisms and its continents having evolved together."

***Top:* Polyodon spathula,** **the only living species of paddlefish native to North America.**



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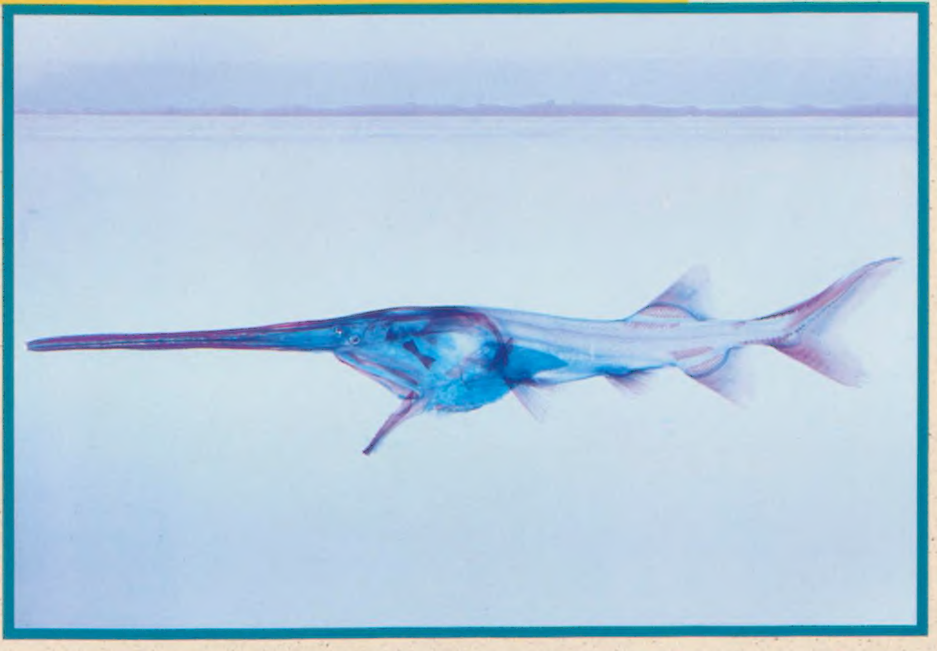
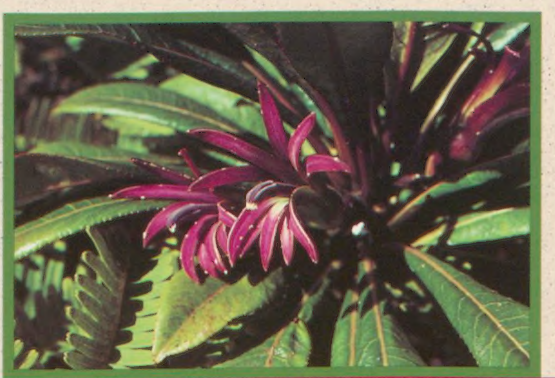


L. GRANDE & W. BEMIS, 1991

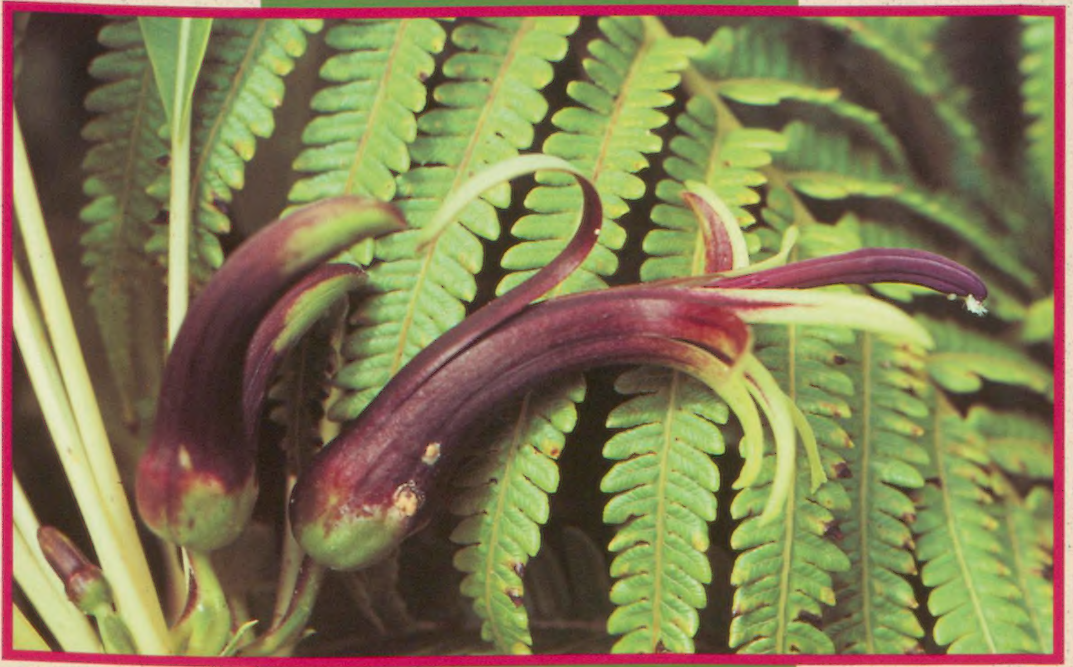
Bottom: **Cleared and stained skeleton of** ***Polyodon spathula,*** **from the Missouri River.**

Top: Clermontia montis-loa, **photographed in rain forest along the Wailuku River, windward slopes of Mauna Kea, island of Hawaii. Species known only from this locality.**

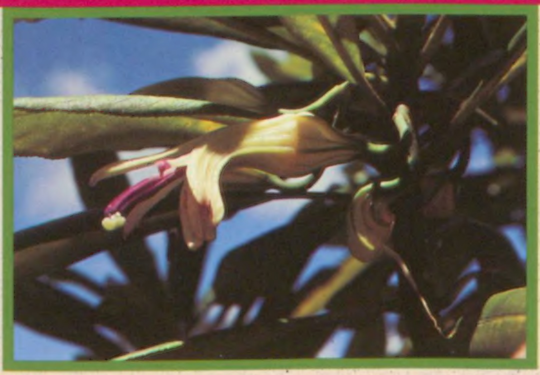
Middle: Clermontia pallida, **species known only from island of Molokai. Photographed in montane rain forest at Kamakou Preserve, elevation 3600 ft.**



T.G. LAMMERS



T.G. LAMMERS



T.G. LAMMERS

Bottom: Clermontia hawaiiensis, **found only on windward slopes of Mauna Loa, island of Hawaii. Photographed near entrance of Hawaii Volcanoes National Park.**

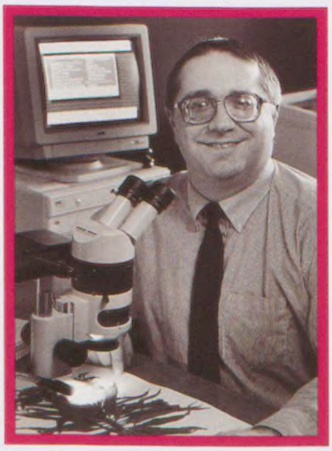
Defying Convention

EVER SINCE DARWIN IN THE Galapagos, systematic biologists have looked to islands—both real islands in the ocean and metaphorical islands separated from neighboring ecosystems—for insight into the processes of evolution. The Hawaiian chain has been a favorite subject. It harbors more endemic species, those peculiar to the territory, than any other place on earth. At the end of the 20th century, however, Hawaii's native species are experiencing rapid decline.

Endemism in Hawaii, as in other isolated places, is often the result of adaptive radiation: A few species, airborne or carried on the waves, manage to reach a barren place; mutant descendants find "niches" in the environment where there is little competition for resources; and speciation occurs—the proliferation of related species adapted to specialized local environments. The most famous example is the Hawaiian honeycreeper, more than forty species of birds descended from a proto-finch that arrived some 20 million years ago. Moreover, ancestral species of plants and animals are typically found on the older islands and descendant species on the newer islands.

T.G. LAMMERS

But at least one large group of endemic Hawaiian organisms is especially interesting because it defies these patterns. Hawaii is the unique home of 110 of the world's 1,200 extant species of the Lobelia family of flowering plants. The leaves, stems, and flowers of lobelias vary significantly. Some species are tree-like, others are small shrubs; the leaves of some are quite slender while others have leaves that are deeply lobed. But despite these variations, they have not spread to diverse environments. The lobelias all tend to occupy the same ecological niche—the high-elevation rain forest. And at least one group of species, *Clermontia*, seems to have originated on Maui and spread to both older and younger islands.


J. WEINSTEIN/GN-86267.13

Field Museum botanist Thomas G. Lammers is one of only three or four researchers in the world specializing in the lobelias. At the age of 35, he expects to devote his entire professional life to achieving a revised classification for the whole worldwide clan of lobelias and to understanding their evolution, life cycles, and population dynamics, applying multidisciplinary methods to the analysis of the group. For the near term, however, his focus is on Hawaii, where scientific investigation of the group must race against an accelerating pace of extinction.

Thirty-five species—one-fourth of the endemic Hawaiian lobelias—have gone extinct in this century. Lammers has determined that the sugars in the nectar of Hawaiian lobelias are mainly fructose and glucose, the types preferred by perching birds such as the honeycreepers. But half of these bird species are known or presumed to be extinct. And while lobelias can pollinate themselves, long-term inbreeding could lead to loss of vigor. Reduction in cross-pollination is only one aspect of the problem. The lobelias are also threatened by foraging goats and pigs and by human encroachment on their habitat.

***Top:* Lower flume at Waikamoi Stream on windward slopes of Haleakala, island of Maui. Rain forest locality containing 7-8 species of lobelias.**

***Bottom:* Dr. Thomas G. Lammers in the process of describing *Siphocampylus platysiphon*, a new species of lobelia collected in Peru.**

FOR ABOUT FIFTY YEARS, between 825 and 875 A.D., the famous Silk Road of the Sea, a major trade route linking China, Southeast Asia, India, Africa, the Middle East, and the Mediterranean, took an overland detour across the narrow Isthmus of Kra in southern Thailand. The reason for the detour is not clear—some have suggested warfare, political problems, or piracy in the region around the Straits of Malacca near Singapore where the sea route normally ran. But Field Museum anthropologist Bennet Bronson and his colleague Chuimei Ho have determined that the twin ports of Ko Kho Khao (on the Gulf of Thailand side of the isthmus) and Laem Pho (on the Andaman Sea) flourished briefly and then disappeared. Nevertheless the remains of goods at the two sites have revealed much about ancient patterns of trade and technological development.

J. WEINSTEIN/GN-86269.25A

Kilns in northern and central China made the world's finest stoneware and porcelains, but a large proportion of the sherds found at the Thai sites was from kilns in the south near Guangzhou (Canton) that produced less luxurious "china." Chinese customs records do not indicate that these southern wares were exported, so the implication is not only that manufacturers in the 9th-century south had developed the technology to make high-volume, mass-market items, but that they had been shipping them surreptitiously to avoid export duties.

Similarly, the Chinese were importing Middle Eastern glassware, since they did not themselves have the technology to make blown-glass vessels.

Porcelain Power

These findings work their way into Bronson's general studies of trade and technology. While it is commonly assumed that trade among ancient civilizations focused on luxury items, Bronson maintains that only those countries that could export items of daily use could hold their own in a mercantile world. Textiles, for example, can serve to keep a person warm or to show that he's a king, but there are many more people who need to keep warm than people who need to demonstrate their royal status. India was the textile center of the world for 2,000 years, producing both expensive and mass-market cloth for export. "If you concentrate only on expensive, low-volume goods," Bronson observes, "someone else will come into the market. Manchester [England] destroyed native textile industries around the world."

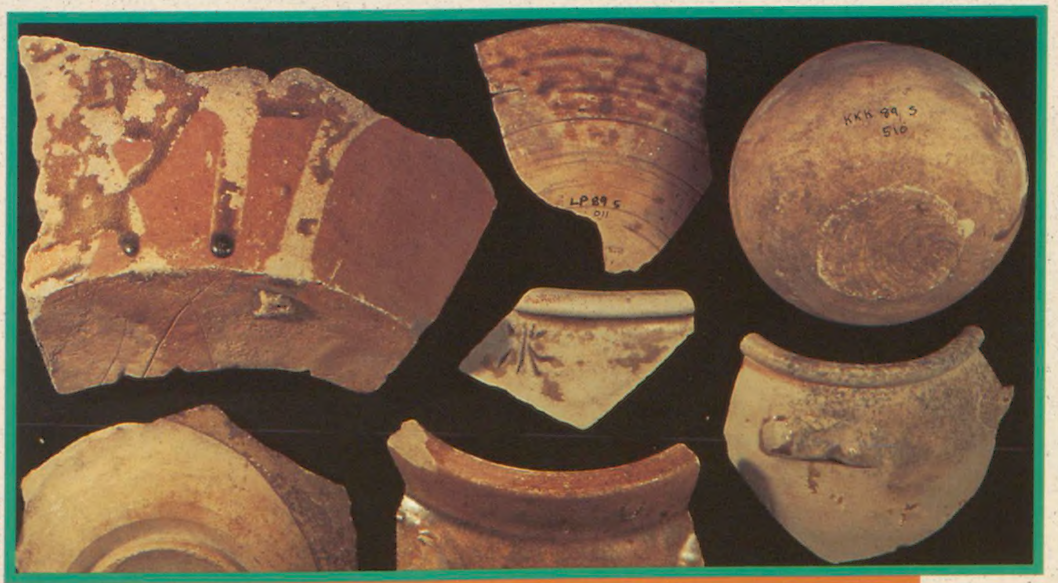
C.M. HO

***Top:* Dr. Bennet Bronson examines slides of objects excavated at Ko Kho Khao and Laem Pho, southern Thailand, during the 1989/90 field season.**

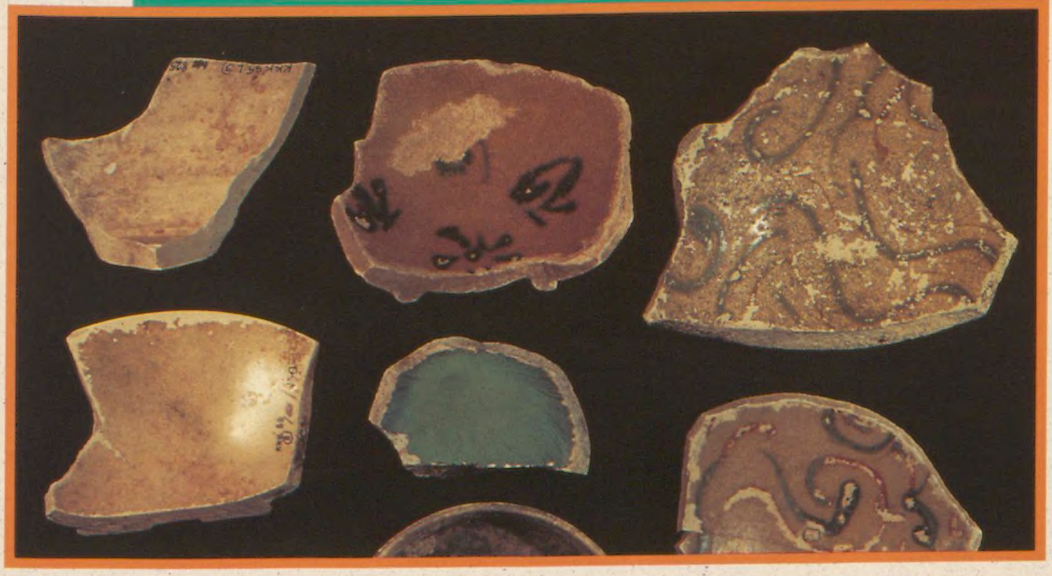
***Bottom:* Bronson drawing strata in a trench at Structure I, Ko Kho Khao.**

But the rise of Manchester was possible only because Britain had conquered India by force of arms; otherwise the looms of India, the most sophisticated and productive in the world, would likely have made that country the first great global industrial power. In a survey of the records of the Dutch East India Company for the late 17th century, Bronson concluded that the value of Indian textile exports to Southeast Asia was about seven times greater than all Chinese exports combined. In that period, India was also shipping 40 million yards of cotton cloth to Britain annually. Not for another 150 years would Manchester be able to sell as much to India.

Top: **Sherds of green-glazed Guangdong stoneware; made in southern China, ca. A.D. 850. Excavated at Ko Kho Khao and Laem Pho.**



B. BRONSON



B. BRONSON

Bottom: **Sherds of Changsha stoneware with blue/green and brown underglaze designs. Made in central China, ca. A.D. 850. Excavated at Ko Kho Khao and Laem Pho.**

Into the Wild

THE MUSEUM'S NEWEST MAJOR exhibit complex, "Into the Wild: Animals, Trails & Tales," in the Daniel F. and Ada L. Rice Wing, enlists a host of interactive and hands-on elements to engage the visitor in learning how to think about diversity in nature. But at its heart are two very traditional kinds of museum display.

Front and center, in the introductory "Nature Walk" exhibit, are many of the Field Museum's magnificent dioramas of realistically posed animals in reconstructed habitat groups. Some of these, like Carl Akeley's 1902 setting of "The Four Seasons" in a Michigan woodland, are nearly as old as the Museum itself, beautiful, priceless, and irreplaceable. Akeley and his disciples revolutionized the art of museum taxidermy and dioramas, and no one has ever improved on their work. In "Nature Walk," the dioramas are enhanced with lighting, sound effects, a nature-trail environment, and numerous activities for both children and adults.

Debra Moskovits, who was co-developer of "Into the Wild" with Barbara Becker, describes these dioramas as "the unique treasures" of natural history museums. "The kind of taxidermy that was being done at the turn of the century is almost a lost art," she says. "What was missing in the old exhibits was life, and connection with the public. And the scientific information was outdated. Our mounted specimens still represent state of the art in taxidermy. What we had to do was make them come alive with state-of-the-art communication techniques, and reinterpret them with current, exciting information."

Deeper into the exhibit complex is an even more traditional form of display: case after case of birds, birds, and more birds, twelve hundred specimens in all, everything from common gulls to the extinct great auk. Here too, the exhibit plays to the Museum's great strength in collections but arrays the specimens in inviting groups that illustrate different aspects of evolution. So comprehensive are these exhibits — the "Field Guide to North American Birds" and "World of Birds"—that no zoo or nature film could rival them. On display are 98 percent of all North American bird species, and representatives of every order of birds and 90 percent of the world's bird families.

The evolution of mammals is explored in the fourth part of the complex, "The W.K. Kellogg Foundation World of Mammals." From mammals whose ancestors already were around in the days of the dinosaurs, to elephants and whales, the exhibit probes problems of adaptation and evolution that continually surprise visitors. (Elephants and whales, the largest land and sea creatures, both evolved from hoofed ancestors.) Finally, in the section on primates, the visitor draws back a curtain and sees, in a mirror, *Homo sapiens sapiens*, one of the most unusual members of the group.

"Messages from the Wilderness," another group of animal exhibits featuring ecology and conservation themes, will open in November 1992, along with a multimedia study center in the Daniel F. and Ada L. Rice Hall.

J. WEINSTEIN/GN-86208.1

J. WEINSTEIN/GN-86210.9

***Top:* Partial view of Cat family display in "Carnivore Corner," one of five "rooms" in the "World of Mammals" exhibit.**

***Bottom:* Young visitors learn about scientific classification with the help of the interactive "Panda Game."**

J. WEINSTEIN/GN-86098.11

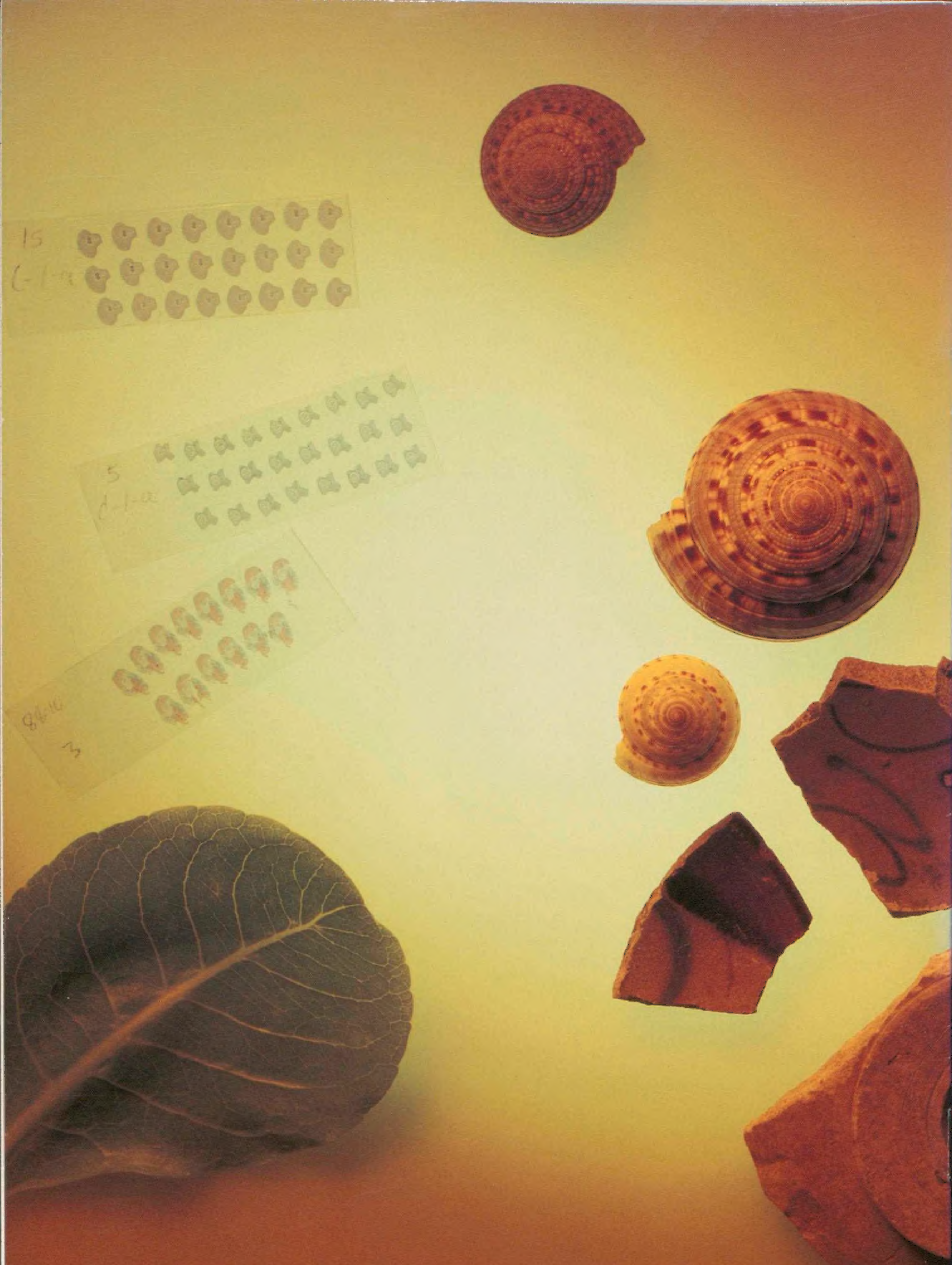
Top: **View of the colorful diversity of birds in "World of Birds."**

Middle: **Diorama of Rocky Mountain Goats in the mountains of British Columbia; created in 1926. Part of the "Nature Walk" exhibit.**

J. WEINSTEIN/Z-93887.2

Bottom: **View of "Early Mammals" room, with a glimpse of "Hoofed and Marine Mammals" room behind. Suspended from ceiling is skeleton of a Black Right Whale.**

J. WEINSTEIN/GN-86102.2



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